US Army Corps of Engineers®

Ice Engineering

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire

Ice Jams, Winter 1995–96

An ice jam is an accumulation of ice in a river that restricts water flow and can cause a considerable amount of water to back up and flood low-lying areas. Areas below the jam can also be affected when it releases, sending excessive water and ice downstream. The rapid rise in water levels often leaves little time to prepare for flooding. Damages caused by ice jams can be extensive, affecting roads, bridges, buildings, and homes, and can cost the affected community thousands to millions of dollars (Fig. 1).

Accurate and reliable ice jam data are essential to prevent and alleviate the damages caused by ice jams. The Cold Regions Research and Engineering Laboratory (CRREL) Ice Jam Database is a compilation of freezeup and breakup ice jam events in the United States (White 1996). The Ice Jam Database is a useful tool in characterizing ice jams for specific areas and for providing information during emergency ice jam flood situations.

CRREL also has an Ice Jam Archive that contains hard copies of National Weather Service (NWS) reports, newspaper articles, and other reports used as sources for ice jam data for 1996 and for other years in the database (Herrin and Balch 1995). The information can be checked out or photocopied for research.

This *Ice Engineering Information Exchange Bulletin* provides a brief summary of ice jam data for Water Year (WY) 1996 (October 1995 through September 1996) contained in the Ice Jam Database. Currently there are 272 entries for WY 1996, the highest number of recorded ice jams since 1960, which had 326 ice events. A substantial amount of the information for 1996's ice jams came from NWS Bulletins. Other sources include CRREL trip reports, Corps of Engineers data, and newspaper articles. Of the 1996 events, 54.8% reported damages, including flooding and other damages to homes, roads, and buildings. Only 3.3% of the entries for 1996 provide dollar amounts for damages.

Figure 1. This house on Ladue Street in Morrisonville, New York, was pushed from its foundation as a result of an ice jam that occurred in February 1996.

When did ice jams occur in 1996?

The greatest number of ice jams in 1996 occurred during January and February, composing 87% of the events entered in the database. During January 1996, the most reported ice jams occurred on the 19th (25.6%), and during February the most ice jams occurred on the 9th (Fig. 2). Weather patterns during January created favorable conditions for ice jams. In the early part of January, snowfalls set records in the northeast, with more than 20 inches of precipitation in some locations, according to U.S. Geological Survey (USGS) reports (USGS 1996a).

In many areas, cold fronts moved in and were quickly followed by warm temperatures and heavy rain between January 18 and 20. Widespread flooding resulted as snow-

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Abstract

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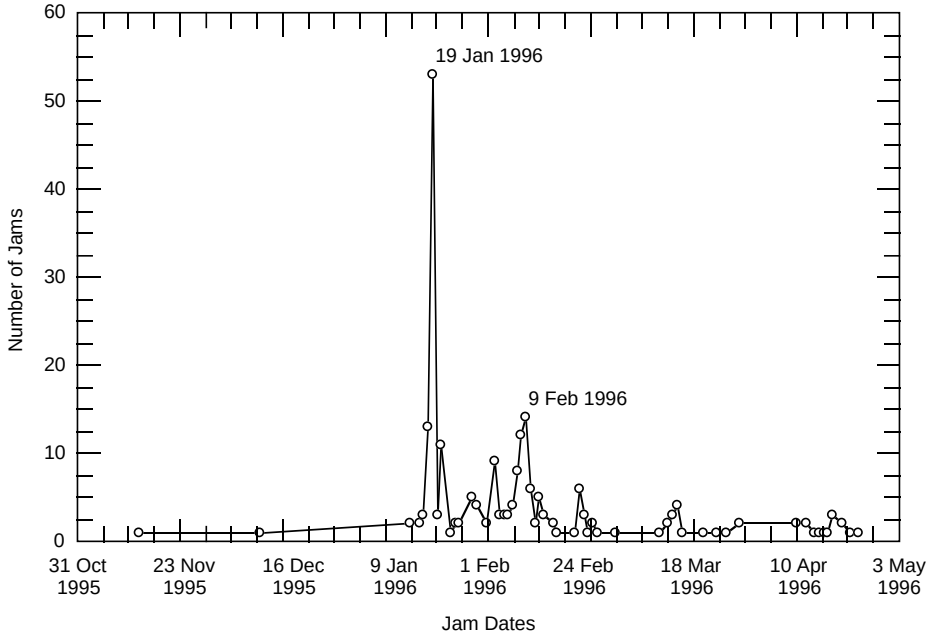

Figure 2. Ice events reported during Water Year 1996.

packs melted, creating rapid runoff leading to ice cover breakup and ice jams. This runoff, combined with ice jams and frozen, saturated ground, caused extensive damage to riverine communities. During February, ice jam floods were common across the northwest as heavy rain and warm temperatures brought streams to bankfull, again breaking ice covers and causing new ice jams or exacerbating existing jams (USGS 1996a).

Where did ice jams occur in 1996?

Ice jams during WY 1996 affected 25 states, with Montana, New York, Vermont, and Pennsylvania being affected most frequently (Fig. 3 and 4). The Missouri, Connecticut, Yellowstone, and Allegheny Rivers had the most entries in the Ice Jam Database (Fig. 5).

The state of Montana reported the most extensive damage due to ice jams during WY 1996. Damage in just ten counties totaled $1.8 million. On February 7, 1996, Governor Marc Racicot declared Montana a disaster area due to flooding caused by ice jams, with flooding in 21 of the state's 56 counties. A major contributor to the formation of ice jams in Montana was above-average snowfall. In most major river drainages in western Montana, mountain snowpack levels were above the 30-year average. In the Bitterroot drainage area there was 21% more snow than the 30-year average and 35% more than the previous year (Devlin 1996). Following the snowfall there were subzero temperatures as low as –33°F, which contributed to the formation of thick ice covers. A warm spell that kept temperatures well above freezing for a week resulted in rapid breakup of river ice covers and the formation of jams (Devlin 1996).

In the Susquehanna River Basin in the states of New York and Pennsylvania, weather conditions were similar to those leading to ice jam flooding in Montana. Snowstorms in early January dumped about 2 to 3 feet above normal throughout the 27,000-square-mile Susquehanna River Basin, with a water equivalent of 3 to 4 inches (Kelley 1996). According to the National Weather Service (NWS), on January 18th and 19th strong winds and dew points reaching into the 50's melted the snowpack covering the entire mid-Atlantic region. A cold front and rainfall moved in on January 19th and 20th, causing massive amounts of runoff, causing flooding.

Pennsylvania experienced the most severe statewide flooding since tropical storm Agnes in June 1972 (USGS 1996b). In approximately 50 locations throughout the state the magnitude of floods was increased by ice jams (USGS 1996b). An ice jam on the Susquehanna River that broke upstream at Turkey Point on January 20, 1996, sent water and ice toward Safe Harbor Dam, requiring flood gates at the dam to be opened to deal with an average daily discharge of 826,000 cfs.

Damage to the Safe Harbor Dam was approximately $20 million according to initial estimates, and the

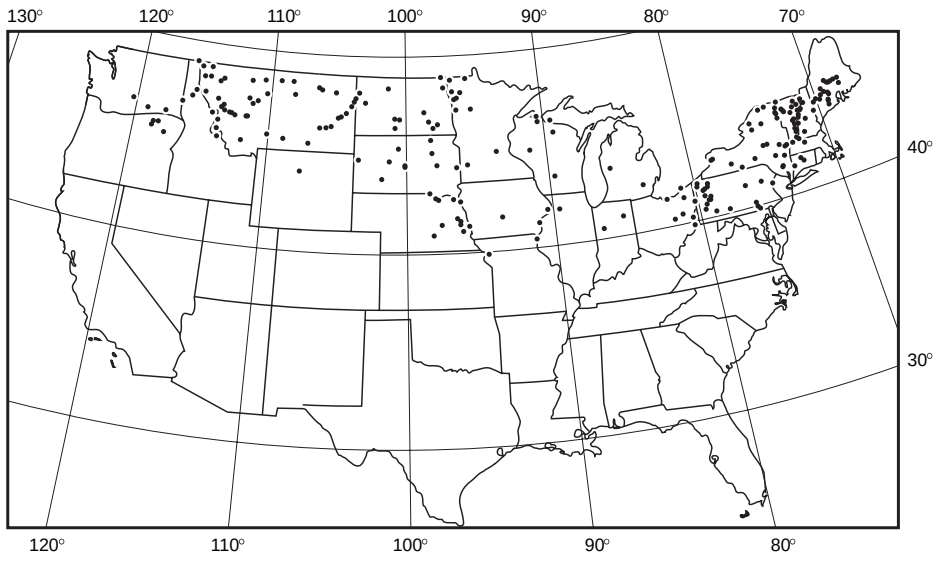

Figure 3. Frequency and location of ice jams during 1996.

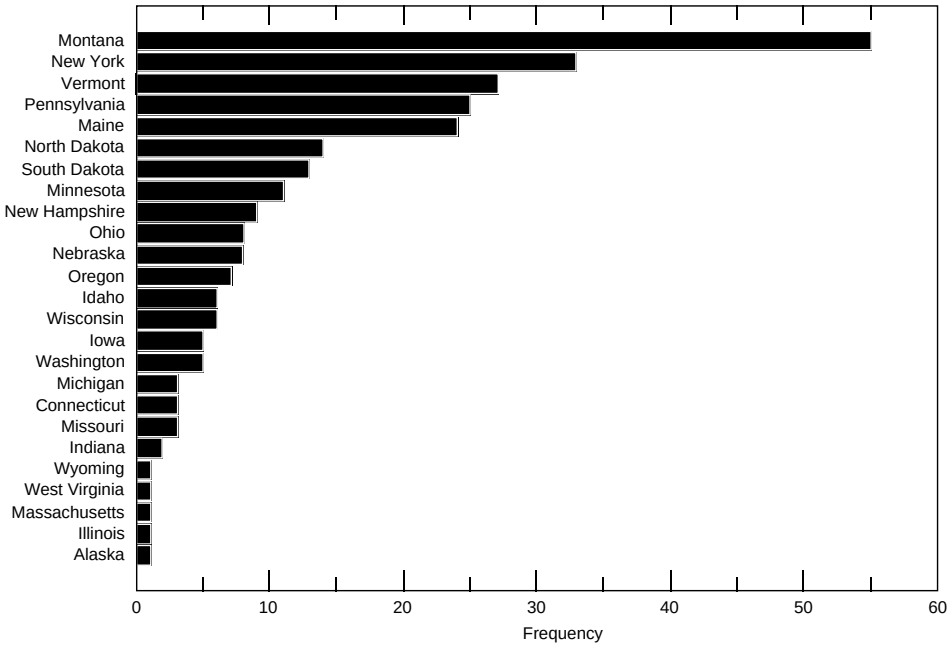

Figure 4. Frequency of ice jams during 1996 by state.

ice jam caused $14 million damage to a mill project (Safe Harbor Water Power Corporation 1996). Downstream from the Safe Harbor Dam, the Conowingo Dam was next to be affected by the wave of water, and eventually the community of Port Deposit, Maryland. Port Deposit experienced severe flooding and reported that it had only half an hour of warning time.

The total amount of ice jam damage in New York noted in the Ice Jam Database for 1996 is over $5 million. According to contemporary Corps Emergency Operations Situation Reports (SITREPS), preliminary damage figures for the ice jams that affected the counties of Lewis, Jefferson, St. Lawrence, and Erie totaled over $1.1 million, with more than 350 homes affected.

Vermont had a total of 27 ice jams noted in the Ice Jam Database for 1996 (Fig. 3). The high frequency of ice jams in Vermont during 1996 was influenced by above-average snowfall followed by heavy rains and warm temperatures (Stahl 1996). Seventy-four percent of these jams occurred between January 18 and 20. The Connecticut and Winooski Rivers reported the most jams, with five and four ice jams, respectively. Ice jams in Vermont for the most part caused mild damages, such as lowland flooding and road closures.

Corps of Engineers response

During the 1996 ice jam flooding, the U.S. Army Corps of Engineers provided resources and technical assistance to alleviate flood damage to affected communities. According to Corps SITREPS, the Corps deployed more than 360,000 sandbags to counties affected by ice jams in the Buffalo, New York, and St. Paul Districts. CRREL provided technical assistance in the form of advice, referrals, and on-site inspections of ice jams in the New England Division and the Buffalo, Chicago, Detroit, Kansas City, New York, Omaha, Philadelphia, Sacramento, Seattle, and Walla Walla Districts.

How is this information helpful?

This overview of the ice jams that occurred during WY 1996 is the beginning of a series of yearly ice jam summaries. We hope to continue updating the Ice Jam Database each year and to provide a publication that summarizes when and where ice jams occurred, resulting damages, and the Corps response. These types of historical data are crucial during emergency situations when information about ice jam locations or stages would be helpful. It is also useful for predicting ice jams. For example, if future weather conditions are similar to those in 1996, one can access information on 1996 ice jams to determine the most likely jam areas and thus carry out appropriate mitigation techniques.

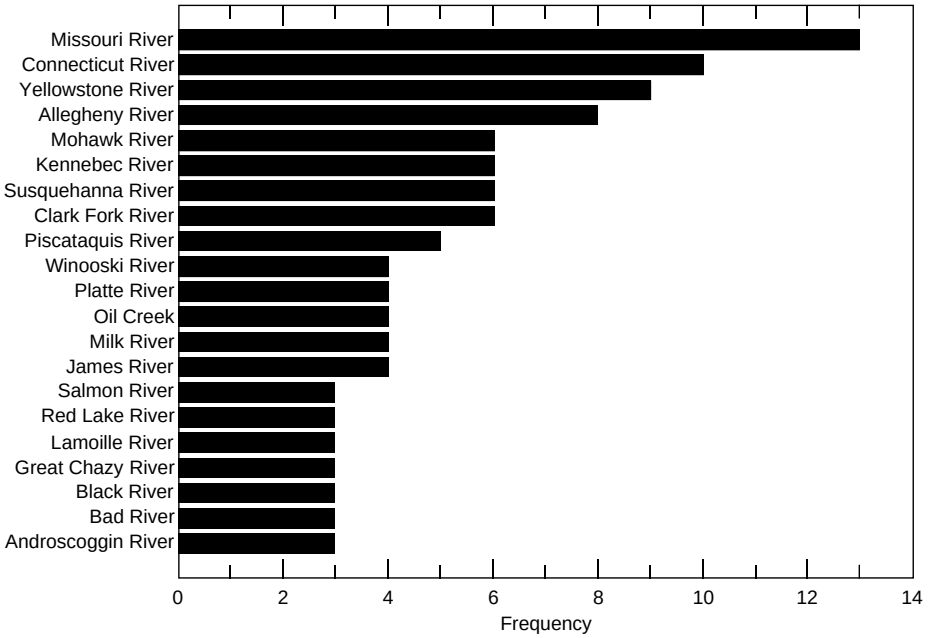

Figure 5. Frequency of ice jams during 1996 by river.

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Please send any information for inclusion into the Ice Jam Database and Ice Jam Archive to Lourie Herrin, Ice Engineering Research Division, CRREL, 72 Lyme Road, Hanover, NH 03755-1290. Originals can be photocopied and returned.

The CRREL Ice Jam Database is available via the CRREL Home Page (http://www.usace.army.mil/crrel/icejam/). The database can be downloaded via anonymous FTP on the Internet; it is located in the "icejam" directory of 144.3.2.11 (bbsun.usace.army.mil). It can also be obtained on CD-ROM by contacting the Ice Engineering Research Division at 603-646-4378.

This issue of the Ice Engineering Information Exchange Bulletin *was written by Ms. Heidi J. Eames, Engineer Aid, of the U.S. Army Cold Regions Research and Engineering Laboratory. Ms. Eames, a student at the University of Vermont, has worked on the CRREL Ice Jam Database for nearly four years. This issue was edited by Gioia G. Cattabriga and laid out by John D. Severance of CRREL's Library and Technical Publishing Branch.*

Ice Engineering Information Exchange Bulletin

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